

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 08 FEB 2006

WIPO



PCT

Applicant's or agent's file reference JCB/P101493WO	<b>FOR FURTHER ACTION</b>		See Form PCT/IPEA/416
International application No. PCT/GB2004/004493	International filing date (day/month/year) 22.10.2004	Priority date (day/month/year) 24.10.2003	
International Patent Classification (IPC) or national classification and IPC H05B6/18, H05B6/02			
Applicant BRITISH NUCLEAR FUELS PLC			

- This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 5 sheets, including this cover sheet.
- This report is also accompanied by ANNEXES, comprising:
  - ☒ sent to the applicant and to the International Bureau a total of 5 sheets, as follows:
    - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

- This report contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand  09.08.2005	Date of completion of this report  09.02.2006
Name and mailing address of the international preliminary examining authority:   European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer  de la Tassa Laforgue  Telephone No. +31 70 340-3696  

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2004/004493

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1-15 as originally filed

**Claims, Numbers**

1-21 received on 12.08.2005 with letter of 09.08.2005

**Drawings, Sheets**

1-3 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2004/004493

---

**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

---

**1. Statement**

Novelty (N)	Yes: Claims	1-21
	No: Claims	
Inventive step (IS)	Yes: Claims	1-21
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-21
	No: Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement.

1.- Reference is made to the following documents:

D1: US-B1-6 576 807 (BRUNELOT PIERRE ET AL) 10 June 2003 (2003-06-10)

D2: US-A-6 121 592 (PEYSAKHOVICH VITALY A ET AL) 19 September 2000 (2000-09-19)

2.1.- Document D1, which is considered to represent the most relevant state of the art to the subject matter of claim 8, discloses (*the references in parenthesis applying to this document*) an apparatus for melting glass using induction heating (*see claim 1 and 17*) comprising a melting vessel (*see Fig. 1, element 3*); and an induction heating coil (*see Fig. 1, element 2*).

2.2.- The subject-matter of independent claim 1 differs from the disclosure of D1 in that *it further comprises* at least two induction heating coils provided at selected locations proximate to said melting vessel; a plurality of power supply circuits each being associated with a respective one of said heating coils and being arranged for selectively supplying power to a respective coil to thereby energise that respective coil; wherein each power supply circuit includes a switching element arranged to prevent or permit the mutual induction of current in a respective heating coil when an adjacent heating coil is energised according to a selected on or off status of the switching element.

2.3.-The problem to be solved by the present invention may therefore be regarded as to provide an apparatus for melting glass using induction in which the temperature distribution can be controlled.

2.4.- None of the prior art documents cited in the search report discloses an indication, hint or teaching that would lead the skilled man towards the solution as defined with the distinguishing features of claim 8 as mentioned above. D2 discloses an induction heating device using a multiple section coil, but this document does not contains any switching element for preventing mutual induction.

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/GB2004/004493

**2.5.-** Independent claims 1, 15 and 17 disclose respectively a method for melting glass, a method for reprocessing waste material and an apparatus for melting glass, using the inventive concept of claim 8. Therefore claims 1, 15 and 17 are considered to be new and inventive.

**3.-** claims 2-7, 9-14 and 16-20 are dependent on the above mentioned independent claims and as such also meet the requirements of the PCT with respect to novelty and inventive step. Their industrial application is also apparent.

CLAIMS:

1. A method for melting glass comprising the steps of:  
providing a current conducting melting vessel within  
5 which glass can be melted;  
providing at least two induction heating coils at  
selected locations proximate to said melting vessel;  
selectively supplying power to said coils to thereby  
selectively energise said coils; and  
10 preventing or permitting the mutual induction of  
current in a heating coil adjacent to an energised  
heating coil by selecting an on or off status of a  
switching element in power supply circuitry associated  
with said a heating coil.  
15
2. The method as claimed in claim 1 further comprising  
the steps of:  
when two or more adjacent coils are simultaneously  
energised during a heating operation, balancing the  
20 heating power delivered to respective zones associated  
with each adjacent coil, in said vessel.
3. The method as claimed in claim 2 further comprising  
the steps of:  
25 during said heating operation in which two or more  
adjacent coils are simultaneously energised, allowing the  
mutual induction of current in said adjacent coils to  
occur.
- 30 4. The method as claimed in any one of claims 1 to 3  
further comprising the steps of:  
selecting which of said at least two induction coils  
is energised at any instant by selectively switching a

switching element, located in power supply circuitry associated with a respective coil, on or off.

5. The method as claimed in any one of claims 1 to 4  
5 further comprising the steps of:

prior to a step of energising a selected coil,  
precharging a capacitor bank and subsequently utilising  
power stored in said capacitor bank during said  
precharging step, during an early stage of energising  
10 said selected coil.

6. The method as claimed in any one of claims 1 to 5  
further comprising the step of providing a 50 Hertz AC  
power supply for supplying power to said at least two  
15 coils.

7. The method as claimed in any one of claims 1 to 6  
wherein said switching elements comprise at least one  
thyristor.

20 8. Apparatus for melting glass via induction melting  
comprising:

a current conducting melting vessel;  
at least two induction heating coils provided at  
25 selected locations proximate to said melting vessel;

a plurality of power supply circuits each being  
associated with a respective one of said heating coils  
and being arranged for selectively supplying power to a  
respective coil to thereby energise that respective coil;

30 wherein

each power supply circuit includes a switching  
element arranged to prevent or permit the mutual  
induction of current in a respective heating coil when an  
adjacent heating coil is energised according to a  
35 selected on or off status of the switching element.

9. The apparatus as claimed in claim 8 wherein:

each heating coil is arranged to provide a heating effect in a respective region of the melting vessel when  
5 said coil is energised.

10. The apparatus as claimed in claim 8 or claim 9 wherein said switching element comprises at least one thyristor.

10

11. The apparatus as claimed in any one of claims 8 to 10 wherein:

said melting vessel includes an input and a drain output and pour output arranged respectively for  
15 receiving glass frit and waste material, draining the contents of said vessel during a draining operation and pouring a molten mixture of said glass and waste material during a pour operation.

20 12. The apparatus as claimed in claim 11 further comprising:

a plurality of induction heating elements each arranged proximate to a respective one of said inputs and drain and pour outputs and arranged to selectively melt a  
25 glass seal closing the input or output to thereby permit the addition of new glass and/or waste material and the outflow of molten material respectively.

30 13. The apparatus as claimed in any one of claims 8 to 12 wherein:

each power control circuit includes a further switching element arranged to selectively charge a bank of capacitors in said power control circuit during a precharge operation.

35

14. The apparatus as claimed in any one of claims 9 to 13 further comprising:

a 50 Hertz AC power supply for supplying power to said heating coils.

5

15. A method for reprocessing waste material comprising the steps of:

locating said waste material together with glass forming material in a current conducting melting vessel;

10 applying power to at least one of a plurality of induction heating coils located proximate to said vessel to thereby heat said glass forming material; and

subsequently pouring a molten mixture of glass and waste material from said vessel into a storage container;

15 wherein

during said power applying step, at least one of said heating coils is energised and mutual induction of current in a heating coil adjacent said energised coil is prevented or permitted by selecting an on or off status

20 of a switching element in power supply circuitry associated with said a heating coil.

16. The method as claimed in claim 15 further comprising the steps of:

25 when two or more adjacent coils are simultaneously energised during said power applying step, balancing the heating power delivered to respective zones associated with each adjacent coil in said vessel.

30 17. A method for melting a target material comprising the steps of:

providing a current conducting melting vessel within which said target material can be melted;

35 providing at least two induction heating coils at selected locations proximate to said melting vessel;

selectively supplying power to said coils to thereby selectively energise said coils; and

preventing or permitting the mutual induction of current in a heating coil adjacent to an energised heating coil by selecting an on or off status of a switching element in power supply circuitry associated with said a heating coil.

18. The method as claimed in claim 17, further comprising the steps of:

when two or more adjacent coils are simultaneously energised during a heating operation, balancing the heating power delivered to respective zones associated with each adjacent coil, in said vessel.

19. The method as claimed in claim 18, further comprising the steps of:

during said heating operation in which two or more adjacent coils are simultaneously energised, allowing the mutual induction of current in said adjacent coils to occur.

20. The method substantially as hereinbefore described with reference to the accompanying drawings.

21. Apparatus constructed and arranged substantially as hereinbefore described with reference to the accompanying drawings.